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RESISTANCE OF HIGH STRENGTH PLATED STEEL TO CORROSION CRACKING

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ABSTRACT: An effective method of increasing the operational reliability of high-strength structural steels in aggressive media is cladding them with a thin layer of corrosion-resistant steel or steel alloy. This article discusses the research done on samples of 42Kh2GSMM steel, test methods and results. A comparison of clad and unclad samples was made.

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Broad use of high-strength structural steels (σ_b > 180 kg/mm^2) is limited because of their decrease in strength in aggressive media. An effective method of increasing their operational reliability can be cladding with a thin layer of corrosion-resistant steel (alloy) [1].

Research was done on samples of high-strength 42Kh2GSNM steel clad with Kh18N10T steel of KhN78T alloy (their proportion to the cross section of sheet, 7--10%) with dimensions 4.5 X 15 X 100 mm, cut crosswise of rolling. The samples were heated to 940° C with air cooling and tempering at 250° C for 4 hours (HV = 650--680 kg/mm^2). Testing was done by a known method [2]. Before mounting the samples in the equipment, a scratch with a depth of 0.3 mm and length 6 mm was made in it in the side being stretched in a direction perpendicular to the line of stretching force. In clad samples, the scratch was cut through the clad layer. Tests in a bath with water-main water lasted for 7 days (see Table). These samples were given a bending load up to σ_{max} = 140 kg/mm^2.

It was established that disintegration both of the clad and the unclad samples began in the area of the defect made. However the time before corrosion disintegration for the clad samples was considerably less than for

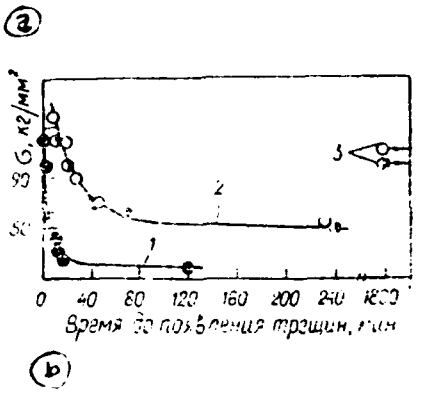
(a)	(b) Среднее время до разрушения образца, ч	(c) Процент разрушенных образцов		
		1 сутки (d)	1,5 суток (e)	2 суток (f)
(1) Сталь 42Х2ГСНМ	10	100	—	—
(2) Плакированная сталь состава: сталь Х18Н10Т+сталь 42Х2ГСНМ+сталь Х18Н10Т	75	20	40	40

Key:
a. Material
b. Average time before breakdown of the sample, hr
c. % of samples disintegrated
d. 24 hours
1. 42Kh2GSNM steel
2. Clad steel composition: Kh18N10T steel + 42Kh2GSNM steel + Kh18N10T steel

the unclad.

A comparative study of long-term strength of clad and unclad 42Kh2GSNM steel was also made in a 20% solution of H_2SO_4 + 30 g/l NaCl. In the course of the experiments the time was determined before the appearance of the first visible cracks on the surface of the samples with a varying level of stress applied. It is apparent that the rate of growth of cracks slows down sharply with a decrease in stress applied. Disintegration has an intercrystalline character. The research data shown in the Figure (each point--the result of testing 3 samples). As is apparent, corrosion-resistant surface layers almost completely put an end to the danger of stress corrosion cracking in high-strength steel. When the level of tensile stress σ_{max} = 140 kg/mm^2 on the samples made of clad 42Kh2GSNM steel (in a case where special measures are taken for protecting the ends which have no cladding) after 30 hours in the solution, corrosion cracks do not occur. Subsequent testing of them for axial stretching did not show a change in mechanical properties.

For removing scale from tempered parts made from high-strength steels, one usually uses sandblasting inasmuch as the the cracks are not permissible in view of the danger of stress corrosion cracking. In our tests, chemical



Long-term Strength During Static Bending in an Aggressive Medium of Samples Made of Unclad (1) and Clad (2--unprotected ends; 3--insulated ends) of 42Kh2GSNM Steel. Quenching and Low Tempering:

--Cladding with Kh18N10T steel,
--Cladding with KhN78T alloy

Key: a. kg/mm^2
b. Time before the appearance of cracks, minutes

etching was done on sheets of clad 42Kh2GSNM steel with dimensions 4.5 X 500 X 800 mm in sulfuric acid baths after thermal treatment for strength σ_b = 180 kg/mm^2. Stress corrosion cracking of the layer of 42Kh2GSNM steel was noted only with unprotected clad ends. Corrosion cracks spread under the cladding layer to a depth of 3--5 mm. After removing the defects, it was established that chemical etching did not reflect on the mechanical properties of clad steel as a whole. Long-term strength of clad high-strength steel in corrosion conditions under stress are characterized by a value close to its maximum strength. If measures are not taken for protecting the ends of clad samples (in practice--a case of local damage to the clad layer or the flange structure), long-term strength is still considerably higher, the rate of stress corrosion cracking is lower than for non-clad samples (see the Figure).

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